

# MATERIAL SAFETY DATA SHEET

## 1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology  
Standard Reference Materials Program  
100 Bureau Drive, Stop 2320  
Gaithersburg, Maryland 20899-2320  
Spectrophotometry

SRM Number: 931g  
MSDS Number: 931g  
SRM Name: Liquid Absorbance Standard  
for Ultraviolet and Visible

Date of Issue: 23 March 2005

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**Description:** A unit of Standard Reference Material (SRM) 931g consists of three kits, each comprising three cobalt-nickel solutions (liquid filters) and a blank solution (12 ampoules total). The liquid filters were prepared by dissolving high-purity cobalt and nickel in a mixture of reagent grade nitric acid and perchloric acid and diluting in distilled water. The blank was prepared as 9 mL/L perchloric acid in distilled water. Approximately 10 mL of liquid is individually flame-sealed in a glass ampoule. Each kit of four ampoules is packaged in a tray, with three trays in each box.

**Substance:** Cobalt and nickel in a mixture of nitric acid and perchloric acid diluted in distilled water.

**Other Designations:** **Cobalt** (cobalt element) and **Nickel** (nickel element) in a mixture of **Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; nitryl hydroxide; nital) and **Perchloric Acid** (dioxonium perchlorate; perchloric acid solution; perchloriate solution; hydronium perchlorate) diluted in distilled water.

## 2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Number	EC Number (EINECS)	Nominal Concentration
Cobalt	7440-48-4	231-158-0	Level I: 3.7 g/L Level II: 7.35 g/L Level III: 11.05 g/L
Nickel	7440-02-0	231-111-4	Level I: 3.45 g/L Level II: 6.95 g/L Level III: 10.35 g/L
Nitric Acid (70 %)	7697-37-2	231-714-2	Level I: 15 mL/L Level II: 22.5 mL/L Level III: 32.5 mL/L
Perchloric Acid (70 %)	7601-90-3	231-512-4	Level I: 25 mL/L Level II: 45 mL/L Level III: 62.5 mL/L Blank: 0.1 mol/L

**EC Classification:** O, C, Xn  
**EC Risk (R No.):** 5, 8, 35, 40, 43, 53  
**EC Safety (S No.):** 1/2, 23, 24, 26, 28, 36/37, 45, 61  
**EC Risk/Safety Phrases:** See Section 15, "Regulatory Information".

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### 3. HAZARDS IDENTIFICATION

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**Nitric Acid**  
NFPA Ratings (Scale 0–4): Health = 4 Fire = 0 Reactivity = 2

**Perchloric Acid**  
NFPA Ratings (Scale 0–4): Health = 3 Fire = 0 Reactivity = 3

**Cobalt**  
NFPA Ratings (Scale 0–4): Health = 2 Fire = 3 Reactivity = 0

**Nickel**  
NFPA Ratings (Scale 0–4): Health = 2 Fire = 0 Reactivity = 0

#### Potential Health Effects

##### Eye Contact:

Direct contact may cause pain, lacrimation, photophobia, and burns, possibly severe. The degree of the injury depends on the concentration and duration of contact. Chronic exposure may cause conjunctivitis.

##### Skin Contact:

Acute direct contact may cause severe pain, burns, and possibly brownish or yellowish stains. Dilute acidic solutions may produce mild irritation. Effects depend on the concentration and duration of exposure. Chronic exposure may result in dermatitis or effects similar to acute exposure.

##### Inhalation:

Inhalation of acidic substances may cause severe respiratory irritation with coughing, choking, and possible burns of the mucous membranes. Other symptoms may include dizziness, headache, nausea, and weakness. Depending on the concentration and duration of exposure, chronic exposure may cause erosion of the teeth and inflammatory and ulcerative changes in the mouth. Bronchial irritation with cough and frequent attacks of bronchial pneumonia may occur.

##### Ingestion:

Acidic substances may cause circumoral burns and corrosion of the mucous membranes of the mouth, throat, and esophagus. Immediate pain and difficulty to swallow or speak may occur. Epiglottal edema may result in respiratory distress and possible asphyxia. Depending on the acid concentration, chronic exposure may result in inflammatory and ulcerative change in the mucous membranes of the mouth and other effects as in acute ingestion.

##### Target Organs:

Immune system.

##### Medical Conditions

##### Aggravated by Exposure:

Eye disorders, respiratory disorders, skin disorders, allergies, and immune system disorders.

##### Physical Hazards:

May ignite combustibles.

##### Additional Information on Fire and Explosion Hazards:

Refer to Section 10, "Stability and Reactivity".

##### Listed as a Carcinogen/ Potential Carcinogen:

Yes No

X\* \_\_\_\_\_ In the National Toxicology Program (NTP) Report on Carcinogens.

X\* \_\_\_\_\_ In the International Agency for Research on Cancer (IARC) Monographs.

\_\_\_\_\_ X By the Occupational Safety and Health Administration (OSHA).

\*The NTP classifies nickel as an **Anticipated Human Carcinogen**. The IARC classifies cobalt and nickel as **Human Inadequate Evidence, Animal Sufficient Evidence, Group 2B**.

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#### 4. FIRST AID MEASURES

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<b>Skin Contact:</b>	Remove contaminated clothing and shoes. Wash skin with soap and water for at least 15 minutes. Obtain medical assistance, if needed. Clean contaminated clothing before reuse.
<b>Eye Contact:</b>	Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Obtain immediate medical assistance.
<b>Inhalation:</b>	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing by qualified personnel. If breathing is difficult, administer oxygen by qualified personnel. Get immediate medical attention.
<b>Ingestion:</b>	Obtain immediate medical assistance. When vomiting occurs, keep head lower than hips to help prevent aspiration. Never make an unconscious person vomit or drink fluids. If person is unconscious, turn head to side.

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#### 5. FIRE FIGHTING MEASURES

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<b>Fire and Explosion Hazards:</b>	Nitric acid and perchloric acid are negligible fire hazards but are powerful oxidizing agents. May react or explode on contact with combustible materials.
<b>Extinguishing Media:</b>	Apply water from a protected location or use extinguishing media that is appropriate to the surrounding material.
<b>Fire Fighting:</b>	Move containers from fire area if it can be done without risk. Keep unnecessary people away, isolate hazard area, and deny entry. Fire fighters should wear a self-contained breathing apparatus (SCBA) and other protective clothing.
<b>Flash Point:</b>	Not applicable.
<b>Method Used:</b>	Not applicable.
<b>Autoignition Temperature</b>	
<b>Smokeless Rifle Powder:</b>	Not applicable.
<b>Nitrocellulose:</b>	Not applicable.
<b>Flammability Limits in Air</b>	
<b>Upper (Volume %):</b>	Not applicable.
<b>Lower (Volume %):</b>	Not applicable.

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#### 6. ACCIDENTAL RELEASE MEASURES

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<b>Occupational Release:</b>	<b>DO NOT</b> touch spilled material. Keep unnecessary people away. Isolate hazard area and deny entry. Stop leak if possible without personal risk. Small spills: Contain and recover liquid when possible with absorbent non-combustible material. Flush down the spill with a large amount of water. Keep out of water supplies and sewers. Nickel and cobalt are subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
<b>Reportable Quantity:</b>	Nitric acid and nickel are subject to reportable quantities (RQ) under Title III of SARA section 103. See Section 15, "Regulatory Information". These quantities are greater than the unit quantity provided for SRM 931g.
<b>Disposal:</b>	Refer to section 13, "Disposal Considerations".

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#### 7. HANDLING AND STORAGE

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<b>Storage:</b>	Store and handle in accordance with all current regulations and standards. Store in a cool, dry, well-ventilated area. Keep separated from incompatible substances.
<b>Safe Handling Precautions:</b>	See Section 8, "Exposure Controls and Personal Protection". Handle as a corrosive liquid.

## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits					
Hazardous Component	OSHA (PEL)	ACGIH (TLV)	NIOSH	UK OES	UK MEL
<b>Cobalt</b> (metal, dust, and fume)	0.1 mg/m <sup>3</sup> TWA	0.02 mg/m <sup>3</sup> TWA (skin)	0.05 mg/m <sup>3</sup> (10 h) recommended TWA	*	0.1 mg/m <sup>3</sup> TWA
<b>Nickel</b> (metal and insoluble compounds)	1 mg/m <sup>3</sup> TWA	0.2 mg/m <sup>3</sup> TWA (inhalable fraction) (insoluble compounds)	0.015 mg/m <sup>3</sup> (10 h) recommended TWA	1 mg/m <sup>3</sup> TWA (organic compounds) 3 mg/m <sup>3</sup> STEL (organic compounds)	0.5 mg/m <sup>3</sup> TWA (metal and inorganic compounds) (skin)
<b>Nitric Acid</b>	5 mg/m <sup>3</sup> TWA	2 ppm TWA 4 ppm STEL	5 mg/m <sup>3</sup> (10 h) recommended TWA	5.2 mg/m <sup>3</sup> TWA	*
<b>Perchloric Acid</b>	No occupational exposure limits established.				

\* No information found from sources used, relating to occupational exposure.

**Ventilation:** Provide a local exhaust ventilation system. Ensure compliance with applicable exposure limits.

**Eye Protection:** Wear safety goggles. **DO NOT** wear contact lenses in the laboratory. An eye wash station should be readily available near the handling and use areas.

**Personal Protection:** Wear chemically resistant gloves and appropriate protective clothing to prevent skin exposure.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Cobalt (Co)	Nickel (Ni)
<b>Physical State, Appearance, Odor:</b> A white to gray odorless solid.	<b>Physical State, Appearance:</b> A lustrous, white to gray solid.
<b>Relative Molecular Mass:</b> 58.93	<b>Relative Molecular Mass:</b> 58.69
<b>Density:</b> 8.92 g/cm <sup>3</sup>	<b>Density:</b> 8.90 g/cm <sup>3</sup>
<b>Water Solubility:</b> Insoluble.	<b>Water Solubility:</b> Insoluble.
<b>Solvent Solubility:</b> Soluble in dilute nitric acid, hydrochloric acid, and sulfuric acid.	<b>Solvent Solubility:</b> Soluble in dilute nitric acid. Slightly soluble in hydrochloric acid, sulfuric acid. Insoluble in ammonia.

Nitric Acid (HNO <sub>3</sub> ) (70 %)	Perchloric Acid (HClO <sub>4</sub> ) (70%)
<b>Physical State, Appearance, Odor:</b> A colorless to yellow liquid with an irritating odor.	<b>Physical State, Appearance, Odor:</b> A colorless, odorless liquid.
<b>Relative Molecular Mass:</b> 63.01	<b>Relative Molecular Mass:</b> 100.46
<b>Density:</b> 1.503 g/cm <sup>3</sup> (70 % nitric acid)	<b>Density:</b> 1.764 g/cm <sup>3</sup> (70 %)
<b>Water Solubility:</b> Miscible.	<b>Water Solubility:</b> Soluble.
<b>Solvent Solubility:</b> Miscible in ether.	<b>Solvent Solubility:</b> Not available.

**Note:** The physical and chemical data provided are for the individual components. Physical and chemical data for this SRM material as a mixture do not exist. The actual behavior of the solution may differ from the individual components.

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## 10. STABILITY AND REACTIVITY

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<b>Stability:</b>	<input checked="" type="checkbox"/> Stable <input type="checkbox"/> Unstable
	Stable at normal temperatures and pressure.
<b>Incompatible Materials</b>	
<b>Cobalt:</b>	Combustible materials. Acids. Oxidizing materials. Halogens.
<b>Nickel:</b>	Acids. Metals. Bases. Oxidizing materials. Halogens. Reducing agents. Combustible materials.
<b>Nitric Acid:</b>	Acids. Combustible materials. Halo carbons. Amines. Bases. Oxidizing materials. Metals. Halogens. Metals salts. Metal oxides. Reducing agents. Peroxides. Metal carbide. Cyanides.
<b>Perchloric Acid:</b>	Acids. Combustible materials. Metals. Oxidizing materials. Metal oxides. Halo carbons. Halogens. Metal salts. Bases.
<b>Conditions to Avoid:</b>	Avoid contact with combustible materials. Avoid heat. Keep out of water supplies and sewers.
<b>Fire/Explosion Information:</b>	See Section 5, "Fire Fighting Measures".
<b>Hazardous Decomposition Products:</b>	Thermal decomposition of nitric acid can produce oxides of nitrogen. Thermal decomposition of perchloric acid can produce acid halides and oxides of chlorine. Thermal decomposition of nickel can produce nickel compounds. Thermal decomposition of cobalt can produce oxides of cobalt.
<b>Hazardous Polymerization:</b>	<input type="checkbox"/> Will Occur <input checked="" type="checkbox"/> Will Not Occur

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## 11. TOXICOLOGICAL INFORMATION

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<b>Route of Entry:</b>	<input checked="" type="checkbox"/> Inhalation <input checked="" type="checkbox"/> Skin <input checked="" type="checkbox"/> Ingestion
<b>Toxicity Data</b>	
<b>Cobalt:</b>	Rat, Oral LD <sub>50</sub> : 6 171 mg/kg Rat, Intraperitoneal LD <sub>50</sub> : 100 mg/kg
<b>Nickel:</b>	Rat, Oral LD <sub>L0</sub> : 500 mg/kg Rat, Intraperitoneal LD <sub>50</sub> : 250 mg/kg
<b>Nitric Acid:</b>	Human, Oral LD <sub>L0</sub> : 430 mg/kg
<b>Perchloric Acid:</b>	Rat, Oral LD <sub>50</sub> : 1 100 mg/kg Dog, Oral LD <sub>50</sub> : 400 mg/kg
<b>Mutagenic, Tumorigenic Reproductive Data:</b>	Cobalt has been investigated as a tumorigen and a mutagenic effector. Nitric acid has been investigated as a reproductive effector. Nickel has been investigated as a mutagenic, tumorigenic, and reproductive effector.
<b>Health Hazards (Acute and Chronic):</b>	See Section 3, "Hazards Identification," for potential health effects.

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## 12. ECOLOGICAL INFORMATION

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<b>Ecotoxicity Data</b>	
<b>Cobalt:</b>	Fish: Fathead minnow ( <i>Pimephales promelas</i> ) (growth): 112.5 µg/L, 30 h Invertebrate: Pacific oyster ( <i>Crassostrea gigas</i> ) (growth): 10 µg/L, 14 weeks Algal: Blue-green algae ( <i>Anabaena variabilis</i> ) (biochemical): 58 900 µg/L, 0.5 h
<b>Nickel:</b>	Fish: Pumpkinseed ( <i>Lepomis gibbosus</i> ) LC <sub>50</sub> (mortality): 8 000 µg/L, 96 h Invertebrate: Greasyback shrimp ( <i>Metapenaeus ensis</i> ) LC <sub>50</sub> (mortality): 8 850 µg/L, 48h Algal: Blue-green algae ( <i>Nostoc muscorum</i> ) (physiological): 1 000 µg/L, 72 h Phototoxicity: Duckweed ( <i>Lemna minor</i> ) EC <sub>50</sub> (growth): 450 µg/L, 4 h

**Nitric Acid:** Fish: Rainbow trout, Donaldson trout (*Oncorhynchus mykiss*) LC<sub>50</sub> (mortality): 2.8 µg/L, 96 h  
Invertebrate: Water flea (*Daphnia magna*) EC<sub>50</sub> (immobilization): 16 µg/L, 48 h

**Perchloric Acid:** Adverse effects not available.

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### 13. DISPOSAL CONSIDERATIONS

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**Waste Disposal:** Dispose in accordance with all applicable regulations. Cobalt is subject to disposal regulations U.S EPA 40 CFR 262, Hazardous Waste Number D001. Nitric acid is subject to disposal regulation U.S EPA 40 CFR 262, Hazardous Waste Number D002. Perchloric acid is subject to disposal regulation U.S. EPA 40 CFR 262, Hazardous Waste Numbers D001 and D003.

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### 14. TRANSPORTATION INFORMATION

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**SRM 931g:** Liquid Absorbance Standard for Ultraviolet and Visible Spectrophotometry (approximately 120 mL total)  
**U.S. DOT and IATA:** Corrosive Liquid, N.O.S., Hazard Class 8, UN1760, Packing Group II, Excepted quantity (10 mL × 12).

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### 15. REGULATORY INFORMATION

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**U.S. Regulations:** CERCLA Sections 102a/103 Hazardous Substances (**RQ also listed under 40 CFR 302.4, Appendix A**): Listed for nitric acid (RQ 454.5 kg), nickel (RQ 45.45 kg). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at 800-424-8802.

SARA Title III Sections 302, 304: Listed for nitric acid (TPQ 454.5 kg).

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE (health): Yes.

CHRONIC (health): No.

FIRE (physical): Yes.

REACTIVE (physical): Yes.

SUDDEN RELEASE (physical): Yes.

SARA Title III Section 313 (40 CFR 372.65): Cobalt. Nickel. Nitric Acid.

OSHA Process Safety (29 CFR 1910.119): Nitric Acid (TQ 227.27 kg);  
Perchloric Acid (TQ 2272.7 kg)

**CANADIAN Regulations:** WHMIS Classification: Not determined.

**EC Classification:** C Corrosive.  
O Oxidizing.  
Xn Harmful.

**EC Risk Phrases:** R5 Heating may cause an explosion.  
R8 Contact with combustible material may cause fire.  
R35 Causes severe burns.  
R40 Limited evidence of a carcinogenic effect.  
R43 May cause sensitization by skin contact.  
R53 May cause long-term adverse effects in the aquatic environment.

<b>EC Safety Phrases:</b>	S1/2	Keep locked-up and out of reach of children.
	S23	Do not breathe gas, fumes, vapor, or spray.
	S24	Avoid contact with skin.
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
	S28	After contact with skin, wash immediately with plenty of soap and water.
	S36/37	Wear suitable protective clothing and gloves.
	S45	In case of accident or if you feel unwell, seek medical advice immediately.
	S61	Avoid release to the environment.

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## 16. OTHER INFORMATION

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**Sources:** MDL Information Systems, Inc., MSDS *Cobalt*, 17 June 2004.  
MDL Information Systems, Inc., MSDS *Nickel*, 18 March 2004.  
MDL Information Systems, Inc., MSDS *Nitric Acid*, 18 March 2004.  
MDL Information Systems, Inc., MSDS *Perchloric Acid*, 09 December 2004.

**Disclaimer:** Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.